ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, SEPT. 24, 1881.

THE END.

A wasp flew out upon our fairest son,
And stung him to the quick with poisoned shaft,
The while he chatted carelessly and laughed,
And knew not of the fateful mischief done.
And so this life, amid our love begun,
Envenomed by the insect's hellish craft,
Was drunk by Death in one long feverish draught,
And he was lost—our precious, priceless one!
Oh, mystery of blind, remorseless fate!
Oh, cruel end of a most causeless hate!
That life so mean should murder life so great!
What is there left to us who think and feel,
Who have no remedy, and no appeal,
But damn the wasp and crush him under heel?

J. G. HOLLAND.

AT the meeting of the American Society of Civil Engineers, held at their rooms, 127 East Twenty-third Street, on Wednesday evening last, Vice-President Ashbel Welch, Chairman, Mr. D. McN. Stauffer read an interesting paper on "Shaft-Sinking Under Difficulties at Dorchester Bay Tunnel, Mass.," which was afterward discussed over the drawings till a late hour, by most of the members present. As the paper is one that cannot well be given, except in full with the illustrations, we are obliged to omit any further mention of it until after its publication by the society.

FROM a paper read before the Section in Chemical Science of the British Association meeting at York, Eng., "On the Fluid Density of Certain Metals," the following results were deduced:

METAL.	Specific gravity, solid.	Specific gravity, liquid.	Percentage of change.	
Bismuth ...	9.82	10.055	Decrease of volume	2.3
Copper.....	8.8	8.217	Increase "	7.1
Lead.....	11.4	10.37	" "	9.03
Tin.....	7.5	7.025	" "	6.76
Zinc.....	7.2	6.48	" "	11.10
Silver.....	10.57	9.51	" "	11.20
Iron.....	6.95	6.88	" "	1.02

The results obtained with metallic silver are perhaps the most interesting, mainly from the fact that the metal melts at a high temperature, which was determined with great care by the illustrious physicist and metallurgist, the late Henri St. Claire Deville, whose latest experiments led him to fix the melting point at 940 degrees Centigrade.

WE publish elsewhere this week an excellent report on a proposed water supply for the town of North Attleboro, Mass., submitted by C. H. M. Blake, well known throughout the Eastern States for his abilities as a hydraulic engineer, but who has now gone to Mexico to fill an important position under the Mexican National Railway Co. We print the report in full, as it covers so many points of interest to younger members of the profession, who are expecting to be called on to perform future similar duty. Mr. Blake seems to have appreciated the fact that he was reporting for unprofessional clients, and so in as few words as possible he has endeavored to point out the salient features of any public water supply, and then his figures and conclusions for this particular work. What he has written out will save an immense amount of amateur engineering talk by the local wiseacres, who can hardly have any other alternative of adoption but the employment of other engineering examinations, which will probably not recommend itself after the clear and able report already made.

As the season for active field work draws near its close we are in frequent receipt of applications from engineers to have their names placed on our "Engineering Bureau List." In reply we wish to inform the profession that the practical working of that "Bureau" was anything but satisfactory; so widely scattered were the addresses of the applicants; so immediate were the demands of employers; so numerous were the conditions of engagement and so risky the transaction of the business, which had usually to be done by telegraph, and so unsatisfactory were the results in the cases where engagements were effected, that we dropped the whole business, and while the present lively demand for engineers exists we will not enter upon it again. If engineers cannot find suitable positions *now*, they never will. For eight dollars a year they can have a copy each of the *Railroad Gazette* and ENGINEERING NEWS sent to them at any address. These two journals endeavor to give as complete a list as possible of engineering work in progress and projected, and, aside from what is there published, the editors of the journals know scarcely more than their readers. Having these lists, the rest is a matter of personal enterprise and energy, with less of risk and expense than the most insignificant trader assumes when he sets out to get business. As the best place to make money is where money is plenty, so the best place to find employment is where a particular service is in demand. Traveling expenses are not much greater than the costly "waiting for something to turn up" in a city; besides, one gets the "experience," which is a very important item of one's intellectual stock in trade. The engineering profession is an itinerancy; traveling is one of its leading fascinations, and not until quite along in years and after much hard labor and study can even a small proportion of its members hope to be able to "settle down" into a permanent and lucrative position or a private practice. We want to assist all we can in promoting the prosperity of individual members, and to that end our advertising columns are open to them at all times at only a trifle above the cost of composition; there is nothing in an advertisement derogatory to their dignity and there is no method more easy, expeditious and inexpensive than making known their wants through the journals that are conducted specially for engineers and the people who are always in need of their services.

THE ERIE CANAL.

We have received from the Hon. Horatio Seymour, Jr., State Engineer and Surveyor of this State, his annual report on the canals of New York for the fiscal year ending Sept. 30, 1880. The report is replete with useful and interesting information in regard to this great water-way, and is profusely illustrated with maps of the country immediately adjacent, and with drawings of machinery now in successful operation.

The report opens with the statement that the fears expressed by many for the financial success of the canal have proved to be unfounded, as the amount of freight transported on them during the past season has been greater than at any prior time during its history, not even excluding that period when the Mississippi and other routes to the seaboard were closed by the war and the only outlet was the Erie Canal.

The canal tolls for the fiscal year under consideration amounted to $1,164,567.92, being $238,823.19 in excess of the previous year, notwithstanding the early and unexpected close of navigation. "Railroads, by combinations, make rates to the sea-board, against which the shipper would be powerless, were it not for the water-route. The owners of five thousand boats can not be drawn into any pooling scheme by railroads or other lines of transportation."

The reason for the greatly increased business was the cheap rate of carrying that prevailed—the average charge from Buffalo to New York having been six and one-half cents per bushel of wheat, including tolls. This shows the wisdom of reduced tolls, which, before 1869, were about as much as the present cost of transportation, including tolls. The policy pursued will be to decrease the percentage of profit as the quantity increases, and every appliance which science can devise will be used to lessen the cost. In 1861, as the cost of transportation to Chicago was in excess of the value of grain, many farmers used their corn for fuel; that year the tolls were six cents a bushel on wheat, while the past season they were only one cent. The tolls have been gradually reduced during the past year, and, for many reasons, it may be to the interest of the State to reduce them still lower. Everything should be done to receive a paying portion of freight bound west, as boats going loaded both ways could carry east-bound freight at one-half the cost they could if they went west empty. Recognizing this fact, two years ago the tolls on west-bound freight were reduced, and on some articles removed entirely, and as a consequence the east-bound tolls were reduced to a figure which would otherwise have been impossible.

The canals are now under one responsible head, and since this system was inaugurated they have shown a marked improvement, as the facility and ease with which the work of last year was accomplished.

In regard to the danger to the commerce of New York the report says:

"As long as the water-route, consisting of the great lakes, the Erie and Oswego canals and the Hudson River, can furnish a cheaper method of transportation than any other, we are safe. But the past is no guarantee for the future. Philadelphia, Baltimore, Boston and Montreal are doing all in their power to take the commerce from New York. The railroads are expending large sums each year in costly experiments to cheapen transportation. Massachusetts has built the Hoosac tunnel, and Canada has commenced and will, in a few years, complete the finest system of inland navigation in the world. To quote from my annual report of 1879: 'While there is so much reason for congratulation about the improved commerce of our State, it is threatened from a new quarter. Our canals and railroads are alike endangered in the near future by the water-route through the valley of the St. Lawrence. In three or four years from this date, British steamships of nearly two thousand tons will lie at the docks of Chicago and other lake ports, unloading their merchandise, or receiving their cargoes of grain, provisions, etc. While we have undervalued and neglected our water channels, the British government has steadily pursued a policy which will give it a water way into the heart of our country and which will make seaports of our great lake cities, with which it can hold direct commerce by a water-route under its sole control, through the St. Lawrence River. Few commercial events of this century equal the importance of the completion of this design.

"'At Cleveland and Toledo, in Ohio, British vessels will approach near to the center of population and production of our Union, which is now north of Cincinnati. This center, as shown by the census reports, is steadily moving toward a point between Chicago and St. Louis, two great cities, which are even now of more commercial importance than any in our country, except New York. Boston, New York, Philadelphia and Baltimore are marginal towns lying upon the eastern edge of our continent, and remote from the great center of population and production. * * * From Chicago to the foot of Lake Erie on the western borders of this State, the British will have the use in common with ourselves of the lakes through which the past season grain has

been carried for less than two cents a bushel. They will not have to tranship or elevate their grain as Americans must do who send it by the Erie Canal or by railroads; they can continue their voyage through Lake Ontario, the St. Lawrence and the ocean to Europe without making changes of cargo, and free from all charges of storage, elevating, etc. They will only have to pay toll at the locks on the Welland Canal, and on the river above Montreal. On the other hand, the products that go through our State must be transhipped at Buffalo or Oswego, must pay elevating, canal or railroad charges, and in New York must be warehoused or put into vessels. * * * We now find ourselves carried back to the question which agitated our State more than sixty years ago, and which led to the construction of the Erie Canal. The British are so confident that they will wrest the trade of the West from us that they have nearly completed works that will cost more than thirty millions of dollars. This is in addition to about twenty millions spent in early improvements, making about fifty millions paid out to gain the great prize they seek—the control of the carrying trade from the heart of our country to the markets of the world. They do not fear our railroads. While we are neglecting our water-routes they spare no cost to perfect theirs.'"

The report then considers the manner in which transportation can be cheapened on the American water-route, consisting of the great lakes, the Erie and Oswego Canals and the Hudson River. As the larger the vessel the less the cost of carrying, so if our waters will admit vessels drawing even a foot more than can pass through the Welland, a great advantage will be gained over the British route. By removing the obstructions in the channels between the lakes, and by deepening Buffalo Harbor a depth of twenty feet could be obtained, or an excess of six and one-half feet more than the locks on the Welland Canal. The government is now engaged in deepening these channels.

To prove that large vessels can transport their cargoes cheaper than small ones, it is stated that the cost from Chicago to Buffalo is one-half that from Buffalo to New York, although the former distance is twice the latter. To increase the capacity of boats the canal must be deepened, and "if one foot of water is added to the depth of the canal by raising its banks, the present boats can carry fifty tons additional load, and the relation between the size of the boat and the size of the canal will not be disturbed." This would cheapen transportation one cent per bushel, which would be equivalent to removing the tolls. This increase of depth—with no additional load—and the application of power for operating the gates and drawing the boats in and out, would result in a saving of thirty-seven hours in the round trip between Buffalo and New York. The author states that he has made the surveys necessary for this work, and estimates that the work could be done for about one million dollars.

Many streams emptying into the canal carry, in times of high water, a large quantity of mud and gravel; every town along the line pours into it some portion of its sewage; refuse matter is received from the boats; this material accumulates during the year, and in order that the grain may not be delayed at Buffalo it must be removed during a few days in spring. The survey of 1876 showed that the canal bottom had been worn away in the center to a depth of more than seven feet, while the sides had deposits varying from six inches to two feet deep.

It is estimated that this deposit contains 1,000,000 cubic yards, and yet not more than 100,000 cubic yards were removed last year. This amount could be removed by dredges, during the summer, in four years, and at a cost of about twelve cents per yard. The canal would then be eight feet deep. "The necessary plant consists of a dredge, barges, or boats, with water-tight decks, to carry the material away; boxes, with hinged bottoms, into which the material can be dumped while on the deck of the boats, and a derrick for unloading the boxes, and dumping the material on to the banks; also, a boarding boat, for the men and teams."

From the report of Mr. Marvin Porter, Division Engineer of the middle division, we take the following brief extract in regard to cable towing:

"The cable was laid between Syracuse and Utica in July last, and operations commenced in the latter part of the same month, and worked with indifferent success to the close of navigation, and to the detriment of other methods of towing or propelling boats, and damage to the banks and walls on the curved portions of the canal.

"It would increase the annual expenses in maintaining the banks and walls that the tow-boat would displace by coming in contact in rounding the curves.

"Cable towing is adapted only to broad and straight channels where the currents are too rapid for the ordinary methods of navigation by steam, and no doubt can be used to good purpose in such cases, but in a channel no wider than the Erie canal, with frequent curves, it can never be a success, should the State give this system preference over all other methods of navigation.

"Should this system of towing be permitted it will result in great injury to the commerce of the canal, and a permanent damage to the State and city of New York."

PERSONAL.

Secretary Bogart, of the American Society of Civil Engineers, is suffering from an attack of malaria, and is absent from the city for a few days.

Jay Gould controls 11,714 miles of railroad whose value, added to the estimated value of other enterprises he controls, is placed at $616,500,000. This is probably the largest aggregate of capital swayed anywhere by any one man.

Fred. C. Mercur has been appointed Chief Engineer of the West & East Railroad, with headquarters at Durant, Miss. The officers of this new enterprise are; W. H. H. Green, President; C. S. Jones, Vice-President; and H. V. Wall, Secretary.

Walter F. McConnell, Civil Engineer, has closed his office in this city, and will spend the ensuing two years in a journey around the world, going west via San Francisco, and visiting Japan, China, Phillipine Islands, India, Palestine, Egypt, and thence to Europe.

W. E. Everett, of Rye, Westchester County, N. Y., died at Saratoga last Monday morning, and his remains will be taken to Brownville, Jefferson County, for interment. He had sustained several strokes of paralysis, one of which about a year ago rendered him permanently blind. For many years he was attached to the engineer's department of the navy, and he was the inventor of the machinery by which the first Atlantic cable was laid, for which he received several souvenirs in acknowledgment of his success.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 374.)

XC.—SARATOGA SPRINGS.

Saratoga Springs, New York, is in lat. 43° 5′ N., long. 73° 40′ W., 32 miles northwest of Albany. The medicinal properties of the springs were known as early as 1535. The first house was built in 1773.

In 1870–1 water-works were built by the village, taking water from a storage reservoir supplied by springs, which is called the Greenfield rerervoir, and has a depth of 20 ft., and flows an area of 115 acres at 336 ft. above sea level. The town is from 220 to 400 ft. above the sea.

The supply is delivered to the town by direct pumping. The Loughbury engine-house is 259 ft. above the sea, and contains a set of Holly pumps, driven by either steam or water power, the latter being used about one-quarter of the time. An average pressure of 74 lbs. is maintained for domestic pressure. The fire pressure is from 110 to 120 lbs.

The distribution is by cast-iron pipe, of which 17.2 miles were laid to March, 1880, with 133 fire hydrants and 1,346 taps. Thirteen miles of the pipe are of less than 6 in. diameter.

The population in 1880 was 10,822. For four months of the year the visitors are about equal in number to the permanent population. The consumption in 1879-80 was 1,172,818 gallons per day, varying from 780,000 gallons in April to 1,600,000 in August. The original cost of the works was $250,000. The expenditures for the year ending March 31, 1880, were $7,458.57, exclusive of interest, and the receipts $25,378.32. The bonded indebtedness was $232,000.

The works are managed by a board of five commissioners. Henry W. Keith has been the superintendent since 1877.

XCI.—NORWALK.

Norwalk, Ohio, is in Huron County, about equidistant from Cleveland and Toledo. The main street of the town is on a ridge sloping both ways.

Water-works were built by the town in 1870, taking the supply from the Peru branch of the Huron River, a stream about 1¾ miles from the centre of the town, and 58 ft. below it. A dam across the creek forms a small storage reservoir. A new stone dam was built in 1880. The water is led through a flume to the pump well. A gravel filter was made which was ineffective, the water passing horizontally into and through it, and the area of filtering material being too small.

Water is pumped directly into the mains. A Holly engine and pumps were erected in 1870, and removed in 1877, when a Worthington compound engine, with 14-in. pumps of 24-in. stroke, and a Worthington high-pressure engine with pumps of 12-in. bore and 15-in. stroke, were erected and are still in use. The average pressure is 80 lbs. per sq. in., and the fire pressure 125 lbs. The distribution is by cast-iron pipe, of which there were, in 1877, 10.39 miles, all but 2 miles of which was of less than 6 in. diameter. The distribution system was remodeled in 1878 and larger pipe laid. There are now 14 miles of pipe, with 84 hydrants and 354 taps.

The population in 1880 was 5,831, and the daily consumption from 342,800 to 779,800 gallons, averaging 523,696 gallons.

The original cost of the works was $94,710.49. About $80,000 was spent on their reconstruction in 1878. The expenditures for the year ending March 31, 1881, were $4,384.45 for maintenance and $3,321.92 for the new dam. The receipts were $4,133.73.

The works are managed by a board of three trustees. The original works were built by contract and no engineer employed. J. D. Cook, C. E., was engineer of the reconstruction in 1878. A. Joslin is the superintendent.

(TO BE CONTINUED.)

To keep machinery from rusting take one-half ounce of camphor, dissolve in one pound of melted lard; take off the scum and mix in as much fine black lead as will give it an iron color. Clean the machinery and smear with this mixture. After twenty-four hours rub clean with a soft linen cloth. It will keep clean for months under ordinary circumstances.

A BRILLIANT black is produced on iron and steel by applying, with a fine hair brush, a mixture of turpentine and sulphur boiled together. When the turpentine evaporates there remains on the metal a thin layer of sulphur, which unites closely with the iron when heated for a time over a spirit or gas flame. This varnish protects the metal perfectly and is quite durable.

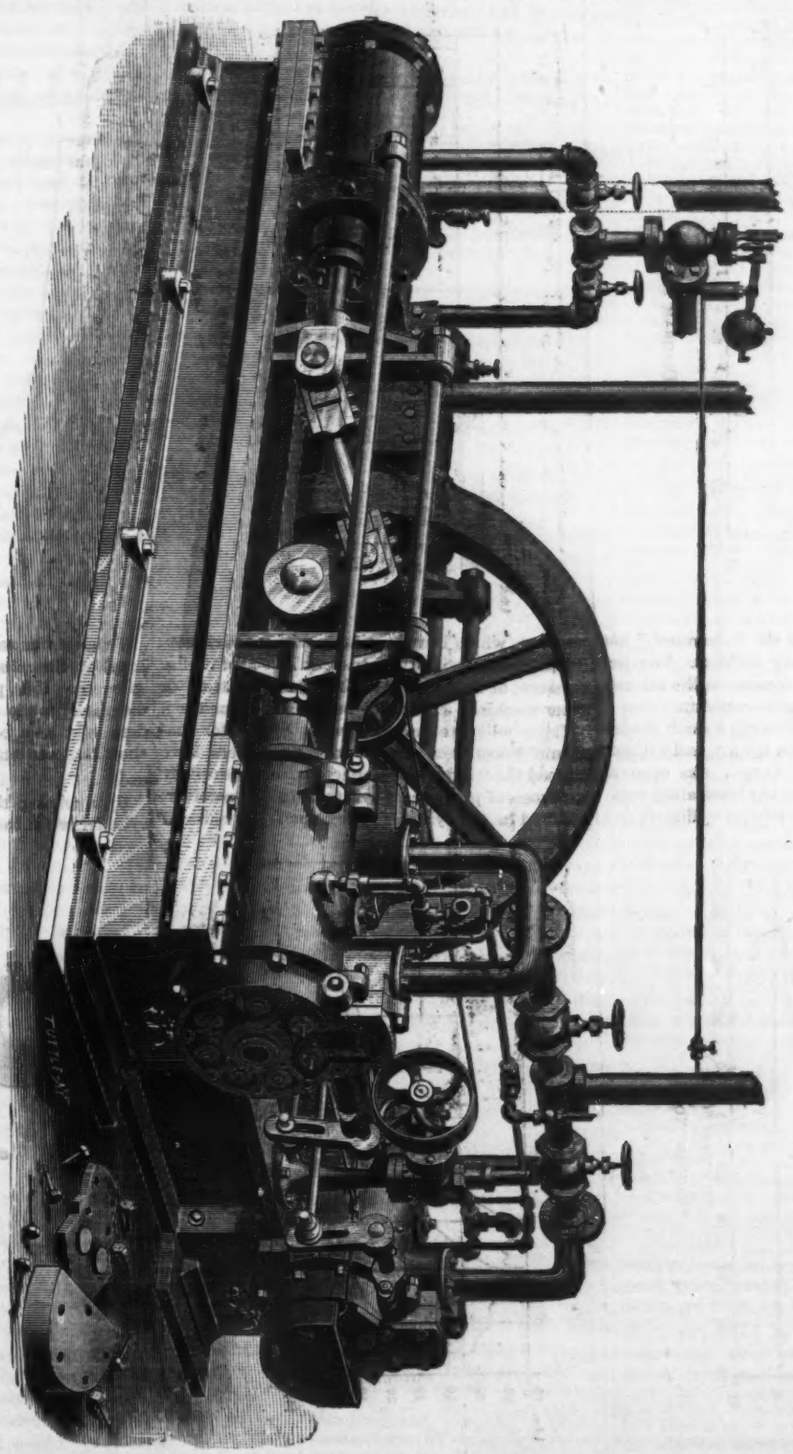
*Copyright 1881.

THE CLAYTON AIR COMPRESSORS.

In the Clayton air compressors a connecting-rod is substituted for the sliding boxes formerly placed in the yokes, which are now allowed to remain sufficiently far apart for its admission, the yokes being rigidly connected on the top by a brace rod, and at the bottom by a distance, which also serves as a slide, running on an adjustable slipper guide (not shown in cut), which takes all the weight of the yokes, rods, pistons, etc., from off the cylinder bore, on which arrangement Mr. Clayton has lately had a patent allowed him.

This mode of combination allows the fly-wheel to be placed in the center of the machine, and admits of the machine being braced from cylinder to cylinder in such a manner as to secure great strength without any unreasonable weight of iron.

Instead of allowing water to enter the jacket and follow its own course to the outlet, it is received at the center of the top of the air cylinder, and the construction of the jacket is such that the cold water is compelled to travel first around the ends of the cylinder, one of which, at the completion of each half stroke, is exposed to the greatest degree of heat developed by the compression of the air. The object of this is to correct any tendency to unequal expansion in different parts of the cylinder.



The induction and reduction valves are both placed in the cylinder covers, and are arranged so that the "valves" and "seatings" can be unscrewed and removed by simply taking off the cover. Pieces of semi-elastic material are interposed between the valve faces and seats, which diminish the shock due to the quick seating of the valves, and protect the metal surfaces from wear, besides being quickly and cheaply replaced when worn.

Probably no one point in the construction of compressors has received more attention than means for reducing the "clearance space" to a minimum. In the air cylinders any air remaining unexpelled at the completion of the stroke will re-expand to its original volume and pressure be-

fore any more is admitted through the proper valves, consequently the capacity of the compressor is reduced at each half stroke by an amount represented by the volume of unexpelled air at its normal density.

The introduction of some fluid, usually water,

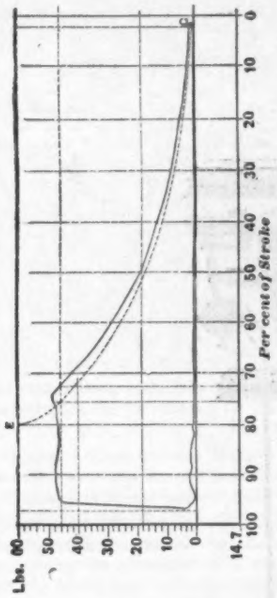


DIAGRAM No. 1.

into the cylinder to fill up the "clearance," has long been practiced by many builders. The improvement herewith shown consists in the manner of controlling and regulating the amount.

The general practice of allowing a small stream under pressure to flow in with the air, and without automatic adjustment and control, was open to serious objections. The revolving lubricating cock, seen in position between the two air cylinders and

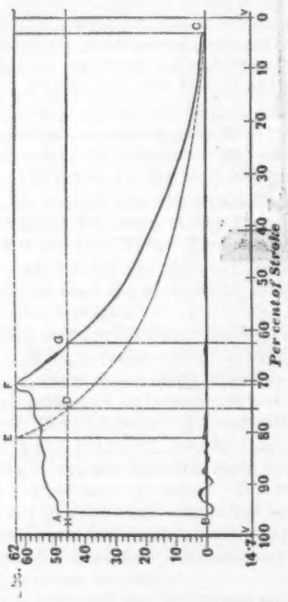


DIAGRAM No. 2.

connected by belt with the main shaft, supplies a measured quantity of fluid to the cylinders at each stroke, maintaining a uniform supply per stroke regardless of the speed at which a compressor is run, and shutting off the supply when not in operation.

The suction valves which open into the air cylinders are supplied with "safety stems," which will prevent any accident from following the breakage of a valve from its stem, which has hitherto been one the most fruitful sources of accidents to air compressors.

The patent air governor (see illustration No. 6) of which Mr. Clayton is the sole licensee, is attached to these compressors. It can be set to any required

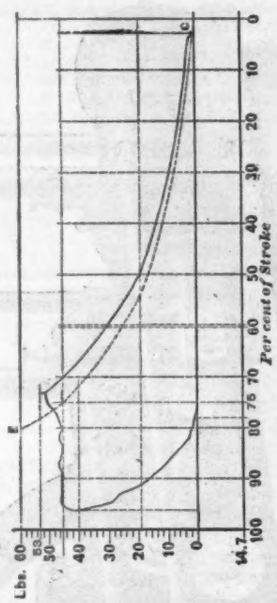


DIAGRAM No. 3.

pressure, which it will maintain without variation, it being immaterial whether steam is at 50 or 100 lbs. pressure, or the number of drills, coal cutters or other machines which may be worked at one time.

Those who are familiar with "indicator diagrams" taken from air-compressor cylinders have noticed the "lump" on the cards, occasioned by the excess of pressure (above that in the receiver) required in the cylinder acting upon the reduced

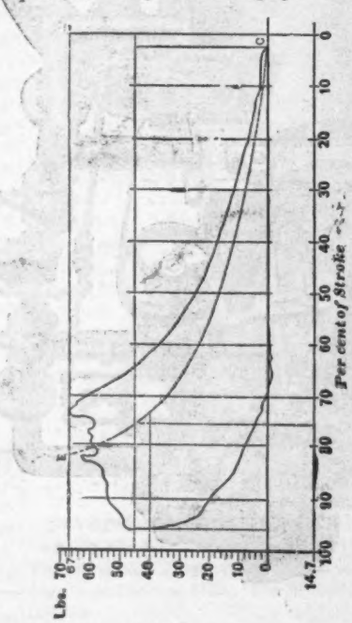


DIAGRAM No. 4.

area exposed to its pressure, as compared with the extent of surface upon which a counter pressure is exerted by the air in the receiver and delivery pipes. This excess of pressure frequently amounts to 30 per cent., and even 50 per cent., and causes a loss of power, as well as subjecting the whole machine to a succession of unnecessary shocks and jars. This difficulty is obviated in these compressors by the use of a tripping device, receiving a positive motion from an eccentric on the main shaft, and which admits of being adjusted to lift the valve at such a period in the stroke as corresponds to the air pressure maintained in the receiver.

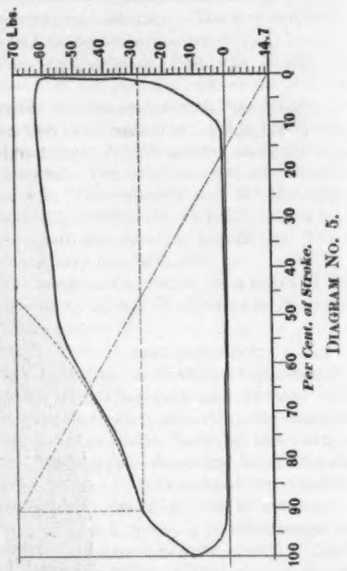


DIAGRAM No. 5.

To assist our readers in forming their own judgment of the value of the foregoing features, we give on this page a series of "indicator diagrams" taken from the air and steam cylinders of these compressors, which very clearly show the percentage of economy effected by their use.

By applying the indicator to the compressor cylinder when the different parts are in position

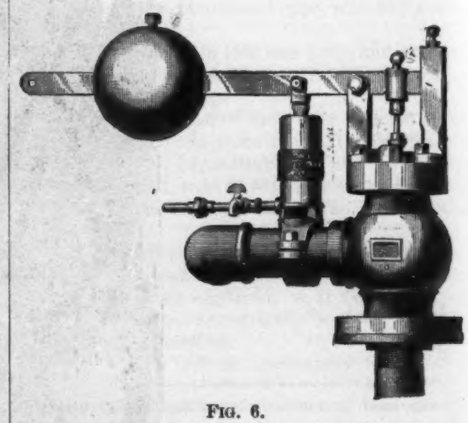


FIG. 6.

a card is given showing the results obtained through the use of the special appliances employed, and when these appliances are omitted one by one in subsequent diagrams, a comparison of results will show the relative value of each feature. These cards are worked up by the same rules as are followed in working up steam-engine cards.

The resistance of the air to the advance of the

piston at a given rate of speed is treated in the same manner as the steam pressure is treated in the ordinary steam-engine card in propelling the piston forward at a given velocity.

The merits of any diagram taken from an air cylinder should be judged according as the compression line follows the hyperbolic curve, which represents an increase of pressure at a constant temperature. An approximation to the curve can be obtained only by the absorption of the heat as rapidly as it is rendered sensible by the compression.

For convenience the hyperbolic curve is shown on all the diagrams accompanying this article, which were taken from a duplex and double-acting Clayton air compressor (same as illustrated), having steam and air cylinders of like diameter, and of equal stroke, while delivering the air into a receiver, the safety valve of which was set at 45 lbs. pressure. Consequently, the resistance was uniform during the trial. The speed also was the same (53 revolutions per minute) excepting when No. 1 was taken.

The speed in this case was increased from 53 to 95 revolutions per minute, in order to determine the limit to which the speed of the air piston could be increased, and still the cylinder be filled with air of normal density before reaching the end of the stroke, when compression commenced, without changing the proportion of "inlet valve" opening to area of piston which is adopted in constructing these compressors.

Card No. 1 was taken from the air cylinder when supplied with water for lubricating the interior surfaces and also filling the "clearance" spaces. Water was supplied the exterior, and the "tripping device" adjusted to act at the proper time in opening the delivery valves. The diagram shows that at the speed at which compressor was moving the action of those parts which could directly influence the action of the indicator was almost perfect. From the point at which "indication" ceased and compression commenced, the pencil followed the "hyperbolic," or curve of constant temperature.

Card No. 2 shows that without the "tripping device," the pressure is raised before it lifts the discharge valve from 46 to 62 lbs., the water running in the cylinder as in card No. 1, but not in the water jacket, and shows how the air is heated and expanded in advance of its full pressure.

Card No. 3 shows the discharge valves lifted automatically, but a heavy loss is occasioned by absence of water from the cylinder, as the compressed air not discharged at the end of the stroke followed the piston back about one-fifth of its stroke.

Card No. 4 is taken from the cylinder without water in the jacket or in the cylinder, and with the discharge valves lifted without the assistance of the toes. This shows a heavy loss of power through the air becoming heated, consequent on entering into a hot cylinder, a great loss of compressed air expanding back in the cylinder and occupying the space which should be filled by fresh air, and an immense waste of power in the power required to lift the valves, viz.: from 45 lbs. —the working or receiver pressure—to 67 lbs., the pressure at which the valves lifted.

This card is probably a fair average of the result which would be obtained by "indicating" the air cylinders of some of the imperfect air compressors at present in use. It is self-evident that a compressor producing such a card would, in a very short period, consume an amount of fuel in proportion to the percentage of effective working power in the shape of compressed air given, the cost of which would equal the price of a new compressor of improved construction.

Card No. 5 was taken from the "steam cylinder" of one of these compressors, and shows the degree of economy attained to in its consumption of steam. The compressor was running at 90 revolutions per minute, with a boiler pressure of 70 lbs., cutting off steam at 52 per cent. of the stroke, and giving an air receiver pressure of 100 lbs.

Taken as a whole, the Clayton air compressor seemes to be as nearly automatic in its action as it well can be, showing that its details have been carefully studied by the designer, and the large sales reported attest the general excellence of materials and workmanship.

Further information can be had by calling on or addressing the Clayton Steam Pump Works, 14 and 16 Water street, Brooklyn, N. Y.

CORRESPONDENCE.

ENGINEERING CLASS VACATIONS.

THAYER SCHOOL OF CIVIL ENGINEERING,
HANOVER, N. H., Sept. 19, 1881.

EDITOR ENGINEERING NEWS:

Having read in the issue of ENGINEERING NEWS just received a notice in regard to summer vacation work of the senior class in civil engineering, Lehigh University, I am moved to write a few lines to state that this has been the policy and successful practice of the Thayer School of Engineering for several years, viz.: Securing professional work for members of the senior class during the preceding summer. This is shown by the inclosed extracts from our recent announcement, a copy of which I sent you a few days ago.

During the summer just ended the four members of the first or senior class have been engaged as follows: Mr. D. C. Barber, in the office of Edw. S. Philbrick, C.E., of Boston, Mass.; Mr. S. B. Cady, on sanitary work for the same engineer, and topographical work for E. W. Bowditch, C.E., of Boston; Mr. E. D. Libby, Assistant Engineer, superintending improvement of Thames River, Conn., under Maj. J. W. Barlow, U. S. Engineer; Mr. J. A. McNicol, on U. S. Coast and Geol. Survey of Vermont and New York under Assist. R. D. Cutts, primary triangulation. They have earned from $50 to $100 per month.

As indicative of the value of a good course of training of a high standard, our small list of graduates at this early period in the life of our Institution already includes three professors (besides one formerly such, but now in the bridge business) and men holding promising positions on railroads and in bridge-works and in government service. Mr. Paul has $4,000 per year, Mr. Worthen $2,100, two or three others $1,500 to $1,800, and the greater part of the remainder from $1,000 to $1,200 and upward.

Pardon me for trespassing so long upon your time; I simply give you these facts, believing they may have some interest as bearing upon the subject of technical education.

Very truly yours, ROBERT FLETCHER.

NORTH ATTLEBORO WATER SUPPLY.

REPORT OF ENGINEER ON WATER-WORKS—SOURCE AND AMOUNT OF SUPPLY—METHOD OF DISTRIBUTION—PLANS COMPARED.

Messrs. Henry Rice, Joseph G. Barden, John B. Peck, Committee on Water Supply, North Attleboro, Mass.

GENTLEMEN: Having been appointed by you to make such surveys and investigations as will enable your citizens to act intelligently on the proposition to supply North Attleboro with water for domestic and manufacturing purposes, and fire service, I beg to submit the following report:

SOURCE OF PROPOSED SUPPLY.

The primary source from which water is derived, whether taken from streams, ponds, springs or wells, is the rain which falls within the boundaries of the water-shed, and the amount of water to be depended upon, the geological and topographical conditions being the same, is in direct proportion to the rainfall and storage capacity. In exceptional cases, where the water-bearing strata in one shed dip toward another water shed, a portion of the rain precipitated will find its way to the adjacent territory. A notable instance is a spring of fresh water on the highest elevation of an island in the Pacific Ocean, which is supplied from a higher source many miles distant, the water passing under the bed of the ocean. The average yearly rainfall in North Attleboro, as observed by Mr. Riesont, of the committee for the records of the Smithsonian Institute, is forty eight inches. It is evident, however, that the *minimum* amount of rainfall is the proper basis from which to estimate the amount to be depended upon for a water supply. The custom now adopted by experienced hydraulic engineers is to take the minimum rainfall for a cycle of three consecutive years as the basis, assuming, on a shed similar in character to the Ten Mile River drainage area, fifty per cent. of the rainfall as flowing into the stream, the other half being lost by evaporation, vegetable absorption, etc. The minimum average rainfall, under the above conditions, may be taken at thirty-eight inches per annum, which would yield nineteen inches as available for storage. This would supply, in round numbers, 900,000 gallons of water per diem for each square mile of water shed, the proportional amount of which could be utilized depending on the storage capacity provided.

The water-shed of Ten Mile River is undoubtedly sufficient in area at Fuller's dam to supply your village with an abundant amount of water of unexceptionable quality for generations to come. The large number of never-failing springs which feed the stream are a great advantage, rendering the river very uniform in its flow, while many brooks, supplied with larger water-sheds where the rainfall is delivered more rapidly, suffer at times an entire cessation of flow. It is evident, as the location from which a supply is to be procured becomes remote from the natural line of drainage, the area of effective water-shed rapidly diminishes, especially in hilly districts, as the slopes are ascended, which is the reason wells on hills are not so reliable as in valleys.

My attention has been called to the possibility of obtaining water for a supply by sinking a large well or excavation near the summit of Watery Hill. The elevation of the hill is such that a comparatively small area could be depended upon for a gathering ground, and although quite a large amount of water would be found, probably, in excavations, it would be merely a question of time when your works would fail, the rainfall being totally insufficient to supply the water required. The elevation of the hill, as will be seen by the accompanying plan, is inadequate to furnish water under suitable pressure for fire service over a large portion of your district without either direct pumping into the mains or the intervention of a reservoir. Direct pumping is now admitted to be injudicious, except where a reservoir, at a suitable elevation, is impracticable; it requires constant attendance, and the necessity of supplying the fluctuations in demand from domestic consumption to fire service, at a moment's notice, which, although the pumping machinery may be first-class, precludes the possibility of obtaining a reasonable "duty" for coal consumed. Numerous instances of the inefficiency of direct pumping for fire service could be produced, but economy alone, in your case, should warrant the construction of a reservoir.

With a reservoir, at a sufficient altitude, gravity furnishes water at a suitable pressure under all conditions, without liability of disaster from accidents to pumping machinery, and the cost of attendance will be nominal for years after your works are in operation. The intervals or meadows through which the Ten Mile River runs, in your vicinity, are mostly of gravel formation, which is termed a *water bearing stratum*, the saturated gravel serving the purpose of a *storage reservoir*, without the objectionable features which exist where land is artificially flowed. An excavation into the gravel will be found to fill rapidly with water after being pumped dry. It would appear, without investigation, that the water must come from the stream, but experiments in many places have demonstrated, beyond a doubt, the fact that most, if not all, the water comes from the adjacent territory, and is intercepted before it finds its way into the stream. It will be found, generally, to be colder in summer and warmer in winter than the water in the stream, will analyze differently, and, at its normal level, will stand higher.

In order to clearly understand the large amount of water which is stored in a gravel formation, favorably located, a few statements may be of interest. If a box of 1 cu. ft. capacity be filled with coarse gravel, it will be found that about two and one half gallons of water can be poured into it without overflowing; in other words, the void

spaces in the gravel amount to about one-third of its cubical capacity. Supposing the water to be sixteen feet deep in such a stratum, there will be stored forty gallons under each square foot of area, or 1,742,400 gallons for each acre. This water can be obtained with as much certainty as if in a visible pond, but not so rapidly, as the friction caused by its passage through the gravel will retard its velocity of flow toward the point from which it is drawn. I should recommend your district to procure a supply of water by means of an excavation into the gravel formation, parallel and adjacent to the Ten Mile River. The details of method for construction will be given in a subsequent portion of this report.

AMOUNT OF WATER TO BE PROVIDED.

The usual custom in modern water-works is to provide for a consumption of 60 gallons per capita per diem, allowing for the healthy increase of population for at least a decade. This covers domestic, manufacturing and fire supplies, sprinkling streets, leakage from pipes and fixture and all demands upon the works. While many places use much less that the above amount, others use nearly double the quantity. Washington, D. C., in 1870, consumed 127 gallons per inhabitant daily, while New York and Chicago use, at times, over 100 gallons per capita per diem. It is probable that for years after your works are completed the daily consumption will not exceed 30 gallons per inhabitant, but statistics prove that the amount required increases much more rapidly than the population, owing to the more general introduction of bath tubs, water closets, etc., and the lavish use of water for sprinkling lawns and other luxuries. I recommend that you provide pumping machinery of 1,000,000 gallons capacity in ten hours, with a distributing reservoir of 10,000,000 gallons storage. By adopting the above plan it will be necessary to pump, for some years after the introduction of water, but one day per week, which will make your operating expenses very light in comparison with the cost of more frequently running machinery of smaller capacity, requiring constant attendance.

METHOD OF PROCURING THE SUPPLY.

I have provided in the accompanying estimates for a filter trench one hundred feet long by eight feet wide on the bottom, with slopes of two feet horizontal to one foot vertical. The bottom of the excavation is to be sixteen feet below the normal level of the ground water. This trench will hold, with sixteen feet depth of water, about 380,000 gallons, which will enable your pump to run to its full capacity without drawing so rapidly on the ground water as would be necessary with a smaller excavation. It is impossible to adopt an arbitrary size for a trench of this description without practical tests in each case, but I think for years to come an ample supply can be obtained by the above plan. It is possible that a series of tubular wells would furnish the water as rapidly as required, but I consider it important, in order to operate your works economically, it should be possible to pump 1,000,000 gallons in ten hours. To do this with tubular wells would require a very rapid draft on the ground water (1,666 gallons per minute), and although the water would be at hand, it is doubtful if the flow would be sufficiently rapid.

MAIN LINE AND DISTRIBUTION.

After carefully considering the probable needs of your community, I am led to recommend sixteen inches as the size for your main line of pipe, for the following reasons: The relative area of pipes of different sizes is as the square of their diameter, which would make the area of a 12-in. to a 16-in. pipe as 144 to 256, but when a large amount of water is to be used for extinguishing a fire, in a short time the *pressure* under which it is delivered becomes an important consideration. The relative loss of head or pressure by friction is very nearly as the square of velocity of flow. An effective fire stream may be estimated to use 300 gallons of water per minute. I consider a contingency may arise when your works would be required to furnish 1,500 gallons of water per minute. In a 12-in. pipe it would require a velocity of flow of 4 26-100 ft. per second to furnish this amount, consuming 29-100 lbs. in friction for each 100 ft. of pipe. A 16-in. pipe, delivering the same quantity, would have velocity of flow of 2 39-100 ft. per second, and consume but 7-100 lbs. pressure for each 100 ft. in length. The importance of properly proportioning the sizes of pipes in your distribution system may be more clearly understood by a practical case.

With the distributing reservoir in Blake's Hill, the *static* or still-water pressure at the junction of Washington and High streets would be 100 lbs. per square inch; suppose a fire should require the delivery of 1,500 gallons per minute at that point. With a 12-in. main the pressure would be reduced to 52 lbs. per square inch, while with a 16-in. pipe it would be 88 lbs. per square inch. Many disastrous conflagrations have occurred from laying too small pipes, and I have aimed, in planning your system of distribution, to adapt the proportions of the pipes to the service they should be prepared to furnish, without losing sight of judicious economy. It should be remembered that where a pipe draws from *both directions* the velocity of flow is reduced one-half, and the loss by friction to about one-fourth the amount if the supply be derived from one end; this, as well as the liability of annoyance from impure water where the circulation is defective, makes it important to avoid "dead ends" wherever practicable.

The weight for the different sizes of pipe on which the estimates are based is as follows:

16-inch	105	pounds	per	lineal	foot
12 "	75	"	"	"	"
8 "	40	"	"	"	"
6 "	30	"	"	"	"

It is customary to allow four per cent. variation from the standard weights of pipe.

The preceding portion of this report is general in its application. In accordance with the instructions of your committee I have investigated two schemes for your proposed works, which will be denominated as plan "A" and plan "B."

Plan A contemplates the construction of a filter trench in the intervale land near the point where the Ten Mile River crosses under Washington street at the foot of Watery Hill, with a distributing reservoir of 10,000,000 gallons capacity on the hill

Plan B provides for a reservoir of same capacity as plan A, located on Blake's Hill, the water to be taken from a trench near Fuller's dam.

PLAN "A."

The elevation of Watery Hill, at the highest point practicable for a reservoir, would permit the high-water line to be 185 ft. above the level of the intersection of High and Washington streets, which will be taken as a point of reference in discussing the two schemes. It would require the water to be pumped about 200 ft. vertically through about one mile of pipe. The location for a reservoir is very unfavorable for economical construction, the indications being that a large amount of ledge would be encountered in excavation. The line for the pipe is also unfavorable; a large amount of ledge would be excavated from the trench. The elevation of the reservoir would be insufficient to furnish an effective fire service in the high portions of your town, without the intervention of fire engines. The source from which the supply would be drawn would in the future, as your population becomes dense, be liable to contamination, but not to the extent were the water taken from the brook direct. The estimated expense is as follows:

Pumping station and machinery	$22,000.00
Reservoir	28,500.00
Filter trench	2,275.00
1,195 tons pipe, at $41	48,995.00
36 tons special castings, at $62	2,232.00
70 hydrants, at $40	2,800.00
8 16-in. gates with boxes, at $95	760.00
5 12-in. gates with boxes, at $58	290.00
13 8-in. gates with boxes, at $32	416.00
34 6-in. gates with boxes, at $24.50	833.00
Laying 10,710 lin. ft. 16-in. pipe, at 46c	4,926.00
Laying 4,800 lin. ft. 12-in. pipe, at 41c	1,968.00
Laying 13,780 lin. ft. 8-in. pipe, at 33c	4,547.40
Laying 20,150 lin. ft. 6-in. pipe, at 19c	5,843.50
2,450 cu. yds. ledge excav. in trenches, at $3.50	8,575.00
	$134,961.50
Engineering and contingencies 10 per cent	13,496.15
Total estimated cost of construction	$148,457.65

PLAN "B."

The reservoir on Blake's hill would have its high-water line 225 ft. above the intersection of Washington and High streets, 135 ft. above the underpinning of Mr. Hall's house on High street, and 135 ft. above the highest point in Attleboro on Washington street. This would give a first-class fire service, except in isolated cases, without the intervention of fire engines. In cases where hydrants are remote from a fire the engines would be required. The level of water in Ten Mile River at Fuller's dam is 29 ft. higher than at the proposed location of the pumping station in plan A, and it is fair to assume the relative difference in elevation of the ground water will be the same. The high water line on Blake's hill reservoir would be 40 ft. above the water in a reservoir on Watery Hill, although the water would have to be pumped but 11 ft. higher.

The estimated expense of works in accordance with plan B is as follows:

Pumping station and machinery	$22,000.00
Reservoir	13,000.00
Filter trench	2,275.00
1,503 tons 16-in. cast-iron pipe, at $41	61,623.00
40 tons special castings, at $62	2,480.00
68 hydrants, at $40	2,720.00
11 16-inch gates with boxes, at $95	1,045.00
3 12-inch gates with boxes, at $58	174.00
13 8-inch gates with boxes, at $32	416.00
34 6-inch gates with boxes, at $24.50	833.00
Laying 18,705 lin. ft. 16-in. pipe, at 46c	8,604.30
Laying 2,800 lin. ft. 12-in. pipe, at 41c	1,148.00
Laying 13,780 lin. ft. 8-in. pipe, at 33c	4,547.40
Laying 20,150 lin. ft. 6-in. pipe, at 29c	5,843.50
650 cu. yds. ledge excav. in trenches, at $3.50	2,275.00
	$128,984.20
Engineering and contingencies 10 per cent	12,898.42
Total estimated cost of construction	$141,882.62

It will be seen by comparing the estimates that the cost in favor of plan B is about $6,500, but there are advantages in scheme B which make the saving really greater than would appear by the estimates. Plainville will undoubtedly take water from your works if they are constructed, as it would be of mutual advantage to the districts to have a supply in common. If the distributing system should be extended from the North Attleboro line to the Messrs. Bacon's jewelry works, an extension which would undoubtedly be demanded at no distant day, no expense would be incurred in plan B except for hydrants, while in plan A a 12-in. pipe would be necessary, costing about $8,300. If such pipe were laid the difference of cost in favor of scheme B would aggregate fully $15,000.

The estimates submitted are made on a liberal basis. Iron pipe at present is quite high, the foundries being overcrowded with work. I think if contracts be made the coming winter, for delivery in the spring, a saving of fully $9,000 could be effected in that item, although the price estimated is a fair one with the present state of the market.

In conclusion, I beg to thank the committee for the courteous treatment received. Acknowledgements are also due C. S. Colbath, Esq., Superintendent of Gas-Works, for valuable information in regard to the character of excavation to be encountered in the streets, and access to plans on file in his office. Respectfully submitted,

C. H. M. BLAKE, Civil Engineer.

PAWTUCKET, R. I., Sept. 12, 1881.

THE OUTLOOK FOR BUSINESS.

Although the rates for money are so high at the present time as to interfere materially with the comfort of regular business, yet the situation looks extremely well, and promises better. The admiration we have always lavished on France as a thrifty and prosperous nation we are now warranted in keeping for home consumption. In point of fact, there is no nation on the face of the earth that is at the present time in more thoroughly fortunate circumstances than our own. Just when our great wheat crops were reported to be all but disastrously below an average, the crops of Europe are found to have fallen off so much from the estimate that what we expected to lose in quantity from our yield we are likely to more than make up in price. And it is mainly for this very reason that speculation in grain is rampant, draining the money-centers of currency and advancing the interest rates to the verge of business prohibition.

Exchange now runs so low, in consequence of the changed relations of Europe and the United States in respect to the wheat and grain crops, that gold importations are again unprofitable and the flow of gold hither from Europe has accordingly begun. There is a good prospect that these importations of the precious metal will be uninterrupted, and continue for some time on an increasing scale. We have the bottom position when we feel sure of a constant demand from abroad for our cereals, If there is less of them in amount this year, they will bring a higher price. And if speculators push their schemes so far as to temporarily check free exportation the effect on general business will show itself soon enough to suggest a satisfactory remedy.

It is a pleasing statement to make in a financial journal that the outlook for the Autumn business is of the most favorable character. Labor was never better regarded nor more contented; and prices promise to be amply remunerative in the future. What are called "good times" are right before us to a certainty. Animation and confidence are the characteristics of all leading industrial enterprises. Cotton and woolen manufacturers are doing well, with every reasonable assurance of soon doing better. Activity prevails in

the mechanical departments of industry also, and both grades of labor are in quick demand. Mechanics are scarce and extremely difficult to secure; the bidding for their services is virtually competitive, so that they can readily find work anywhere and at satisfactory prices.

A glance at the regular returns of the savings banks is enongh to satisfy one of the present condition of labor. They are on the increase all the time. Capital is abundant and cheap, and eagerly seeks remunerative openings. A great number of establishments are making such steady profits as to extend their operations at the cost of their own surplus returns. People are thinking of coming back from their summer interruptions to business, and the general return will be the signal for such an exhibition of energy as will set all the wheels of business humming. We have a gold basis to go upon; our agricultural products are wanted abroad; immigration is adding to our industrial sinews immensely every year; our markets are expanding, and the public debt is rapidly being paid, so rapidly as to provoke the somber vaticinations of the officers of the national banks; industry is prospered and trade is unprecedentedly active; and all the elements of a long career of success are at work about us.

Nothing less than a series of stupendous blunders can well destroy a fabric of general prosperity thus strongly put together. No mere market manipulations, no cornerings of wheat, no artificial stringency of the currency can avail to break up these broad and solid conditions of business success. A few cliques may seek to dam the great current of prosperity, and run it off into canals to run the little wheels of their own private schemes and purposes, but if they count on permanently controling the universal forces that are carrying the country forward, they are destined to be engulfed and overwhelmed.—*From the Boston Economist, Sept.* 8.

THE PULLMANS IN ENGLAND.

Mr. A. P. Rapp, mechanical superintendent of the Pullman palace cars in England, is here on a business visit to the home office of the company. Mr. Rapp said to a *Times* reporter that there are now forty-seven Pullman cars in service upon the English and Continental railways. Sometime ago a hotel car was put on the Great Northern road, between London and Leeds. The run is one of four hours, and the car makes a round trip daily. The success of this undertaking has prompted the Midland Railway Company to order from the Pullman Company a hotel car for service on that line. This car will be run between London and Liverpool. Mr. Rapp added in this connection that no journey could be made by rail in England which affords the traveler so much sight-seeing of a picturesque order as the one through the counties traversed by the Midland Line. The first Pullman sleeper introduced in England commenced running over the Midland Railway in 1874. Mr. Rapp said that ten new sleeping cars, now in process of construction in this country, will be exported in a few weeks for use on the English railways. which additions will swell the total number in the service beyond the sea to fifty seven. The cars built for the English are 4 ft. 8½ in. in gauge, and are not less ornate than the finest sleepers in use on American lines. The question was asked whether or not the cars had proved of too great a width for some of the English lines, owing, as had been reported, to the proximity of platforms to the tracks; and to this Mr. Rapp replied that they are available on any and all the roads in England. Only a few weeks ago President George H. Pullman journeyed in one of his cars over all the lines in Scotland. Mr. Rapp says that on the Edinburgh and Glasgow lines a certain large class of patrons will not undertake a journey by rail except in a Pullman car. They seem to have forgotten that it is an American invention. When the cars were first introduced in 1874, the English railway officials and the people generally predicted the sleepers could never turn the sharp curves on the Midland. The reason they gave was that the cars were too long. The adaption to sharp curves was the merit most particularly claimed for the cars, and, after the trial, the English companies commenced building longer carriages than had ever been in use in that country. Mr. Rapp said, in answer to an inquiry, that the rates charged in England for berths are the same as in this country. The fare from London to Edinburgh, 420 miles, an all night run, is eight shillings, or $2. Speaking of the rate of speed, he said that the run from Derby to London, 130 miles, is made in three hours, with two stops of five minutes each. The special train of Pullman day cars, to be run between London and Brighton, will commence operations in October.—*Chicago Times.*

EARTH-WORK SLIPS.*

The nature of the ground passed through by cuttings upon No. 1 contract of the Nottingham & Melton Railway varied considerably. At the Nottingham end of the line the cuttings were through red marl, with occasionally thin beds of sandstone; to these succeeded several cuttings in boulder clay or drift of most diverse character, in some places being stiff and homogeneous, while in others it was composed of broken shales, sand and clay, all lying together in a confused, contorted and irregular manner; further on, in the last cutting at Broughton, the line passes through beds of the lower shales.

A little water was met in the red marl, where it followed the beds of sandstone, but it caused no partcular harm, being caught by shallow drains along the outcrop of the sandstone in the sides of the cutting, and led away to drains at the foot of the slope. Throughout this cutting, which was more than a mile in length, and at one part nearly 50 ft. in depth, the marl stood exceedingly well at a slope of 1¼ to 1, never giving the slightest trouble, and the embankment formed from the excavated material also stood well at the same slope.

In the cuttings through the boulder clay where the material was homogeneous, no slipping to any appreciable extent took place, but where pockets of sand occurred in the shale and clay, the slopes gave considerable trouble, continually breaking off vertically at the back from the top, after being trimmed to a slope of 1¾, or 2 to 1. Water was generally found in the sand, at the base of the slips, and was apparently the cause of them. These, when small, were frequently cleared away entirely down to the solid, and the line of slope restored by filling in with burnt ballast, broken boulders, or other convenient hard, dry material, which allowed the water at the back to drain off without doing further injury. Where, however, the slip was very large, extending, as in one case, at the north end of Stanton tunnel, 6 or 7 chains along the slope, and from 20 to 40 feet in depth, another method was pursued; a deep drain parallel to the line of railway and 4 or 5 feet wide was taken down at the back of the slip to the solid ground, and filled with burnt ballast; cross drains were cut from it to the face of the slope to bring out the water, and the toe of the slip was secured by being burnt for a width of about 20 feet, the whole being finally trimmed off to a flatter slope.

Two large slips occurred in cutting No. 9 in the lias shales, on opposite sides of the line, somewhat similar in character to those before described, breaking off vertically at the back from near the top of the slope. In this case the bottom of the slips extended underneath the formation of the railway, and the toe of the one being pressed on to the toe of the other, by the weight at the back, caused both slips to turn and rise upward, lifting the ground several feet. In fact, a gang of men had to be continuously employed lowering the temporary roads in order to keep the work going. These were dealt with in the following manner: In addition to drains at the back, and a toe of burnt ballast on each side, the slips were cut down to the solid ground in the center line of the railway, verying from 3 to 9 feet under the formation level, and cleared out for the full width, the space thus excavated being then filled in with rough furnace slag, which entirely prevented any further lifting, and upon which, after being ballasted, the permanent way was laid. The burnt ballast and drains afterward kept up the slopes of the cutting, which were trimmed to an irregular batter.

FAILURES IN RAILWAY EMBANKMENTS†.

The unusual difficulties encountered by engineers during the last five years in the construction of railway earthworks, have been to a great extent attributable to the abnormal state of the weather during that period. In no other class of work can a completely successful result be anticipated with so little confidence, and a satisfactory solution of the difficulty still appears remote. From the great outlay which is often necessary to restore the ground after an extensive slip, it may be questioned whether greater precautions, and consequently increased expenditure during construction, are not desirable. Probably the material does not exist which, if thoroughly freed from the presence and action of water during the process of construction, would fail to form a permanently stable structure; the value of the forces of cohesion and friction depending so largely on this condition.

The separation of the sound or dry material from the unsound is a matter of the first importance, and sufficient attention is not generally given to it. There are differences of opinion as to what constitutes unsoundness, and a practical definition of it is by no means easy. The process of separation frequently involves additional labor on men who require great supervision; land whereon to deposit the soft earth is not always available, and the common practice of casting it out on the sides of the nearly finished bank is unsatisfactory. Where burnt ballast is required, the best method is to light fires adjacent to the cutting, and to burn the wet material. Considerable importance is believed to attach to this point, as the commencement of slips of a serious nature has been traced to the admission into an embankment of two or three wagons of "slurry."

On the recently constructed Nottingham & Melton Railway several serious slips occurred. Some idea of the character of the material may be formed from the fact that one-fortieth of the excavations was burnt into ballast for use on temporary roads only. Great care should be taken to drain transversely the water which collects in the ballast so used, otherwise the temporary road sinking to a lower level than the bank on either side, a trench retaining water is left in the center of the embankment, which is a fruitful source of trouble. The rule adopted on the above line in forming the slopes of earthworks was:

For cuttings and embankments under 25 ft. deep, slope			1¼ to 1
" "	above 25 ft. and under 40 ft. deep	"	1¾ to 1
" "	above 40 ft.	"	2 to 1

Any attempt, however, to arrive at a definite angle of repose for such material is not likely to be successful, several of the slips having assumed a slope of about 8 to 1.

Experience fixes 30 ft. as the limit of height to which it is advisable to carry a bank of blue clay; the necessarily slow progress made in higher banks exposes the earth on the leading face so much to atmospheric influences that, in a bad season, the slope is continually in a soft condition, and is an unfit foundation for the reception of any material. To avoid this evil, by making more rapid longitudinal progress, several of the heavier embankments were formed in two lifts. If, however, the season is a good one, it is better to tip a bank to the full height in the first instance. In tipping it at a lower level there must be a sufficient allowance for settlement, otherwise the base on which the higher lift is to rest will be too narrow. Since this settlement varies in different soils from 2 to 6 in. in the foot, the difficulty in determining beforehand what allowance is necessary, renders this contingency of a narrow base a not unfrequent occurrence, and obviously necessitates beveling the extra width on the slopes of the lower lift, which is always to be avoided. Then, again, the surface of the lower bank being in an uneven state induces the collection of water and consequent saturation of the work.

On sidelong ground, in pasture land, the grass affords a sufficiently smooth surface to induce a movement in the bank. The author believes that a system of surface digging to a depth of 9 inches is preferable to the formation of benchings. The latter need careful drainage, and when cut at right angles to the center line of the railway, the mound formed from the excavation of the benching, being composed mainly of light turfy soil, gives way under the weight brought on it, and so not unfrequently causes a failure extending into the bank. The author recently had occasion to widen an embankment for siding purposes; one part of the slope of the already formed bank was benched, the other surface was dug, and it was found that the latter stood better than the benched portion. In this case, however, though great care was taken to drain the benchings when formed, a settlement may have taken place in the old bank, causing an accumulation of water in the benchings.

Desirable as it undoubtedly is to ascertain, by borings, the nature of the material to be excavated before commencing operations, little or nothing can be learned in this way as to the probability of the subsequent occurrence of slips; nor does it follow that a material which will stand well in cutting will form an equally good bank, and vice versa. The excavation from a cutting on the Nottingham & Melton Railway, which was deposited in a spoil bank, stood well at a slope of 1

* Paper read by Edward Parry, M. Inst. C. E., before the Institution of Civil Engineers, London.

† Paper read by J. W. D. Harrison, Assoc. M. Inst. C. E., before the Institution of Civil Engineers.

to 1 or less; whereas the cutting whence it came gave no little trouble, though its slopes were flattened to 2 to 1. In this case the presence of "backs" caused the trouble in the cutting, the process of excavation and removal obviating this danger in the bank.

Slips are more frequent in autumn, after a dry summer, than at other seasons. The probable explanation of this is that the cracks formed by the sun collect the rain, and where these cracks occur near weak joints of the bank, the bank fails. To prevent, as far as possible, the occurrence of cracks, great care was taken to obtain a good growth of grass. It has been suggested that a layer of burnt ballast 6 inches thick, placed beneath the soil in which the grass is sown, would not only be useful for drainage, but also protect the clay from the effects of the sun.

The slope assumed by plastic clay, when first tipped, seldom exceeds 1¼ to 1. Now although the slope which is ultimately to be given, and which is considered necessary for the stability of the work, may extend to 2 to 1, for reasons of supposed economy in working and to give time for any extra settlement beyond that allowed for, the embankment is usually left at the steeper slope for periods extending in some instances to several years. During this time, it appears to the author that, allowing the more extended batter to be a correct estimate of what is necessary, an excessive strain is placed on the work. The slips which occur while the bank is in this condition are sufficiently frequent to lend some force to this argument. Though these slips may not be of a heavy character, nor even extend beyond the ultimate slope line, it is noticed that they remain weak points in the work and occasionally lead to serious disturbance. To remedy this, it seems desirable that the process of forming the slopes should be carried on as nearly as possible simultaneously with the construction of the body of the bank. The objection to this system on the score of expense is not a serious one; and allowance for further settlement might be made by slightly increasing the width of the formation: indeed, in ground of this character, a somewhat extended formation may be beneficial in other ways. The additional outlay in land in most districts is hardly worth consideration, the main question in cost being the increased quantity of excavation necessary.

In treating slips after their occurrence two methods were mainly adopted:

1st. The toe of the slip was burnt into a compact mass of ballast, the width at the base varying from 8 ft. to 20 ft. or more. This retaining wall, for such it virtually was, having been formed the foot of the slip was weighted as far as possible, and the slope was left concave where practicable, having a versed sine one-thirtieth of its length. The foundation of the ballast heap was 2 ft. below the original surface. In no case did this wall of ballast give way, though in several instances the slip rolled completely over it and a fresh heap had to be formed at a greater distance from the line. As the circumstances were exceptional any details as to cost would be misleading, but it may be stated that 1 ton of coal was sufficient to burn about 10 cubic yards of ballast.

2d. Trenches were cut through the slips at right angles to the direction in which the ground was moving; the width of these trenches varied from 2 to 9 ft., and, having been carried 18 in. or 2 ft. into the solid ground below the line of the slip, they were filled with stones, the whole of the timbering necessary for their excavation being, generally speaking, left in. This is obviously a costly process, and was only adopted in exteme cases, where the slips were delaying the opening of the line. In excavating the trenches it was noticed that but little water was tapped at a lower level than 3 or 4 ft. below the surface. That they must be regarded as counterforts to strengthen the slips more than as means of drainage was shown by the fact that several weeks after their construction the surface of the bank 3 ft. away from the trench was in a soft, boggy condition. Regarding them, then, simply as counterforts intended to strengthen a moving mass of weak material, it was thought that to carry them completely through that mass would defeat the purpose for which they were formed, and allow the slip, or succession of slips, to continue their course between the walls. It was found that carrying them about two-thirds of the way through the slip effectually checked its progress, and it seems probable that a less distance than this would have sufficed.

In all cases, where the trenches extend to the back of the slip, there was no great quantity of water. The cause of the majority of the failures appeared to be the inability of the material to support its own weight, consequent on the quantity of water with which it was charged; that this water is held in suspension for a great length of time appears probable, and the fact that the heaps of ballast over which the slip had rolled were found, when opened out, to be in a dry and dusty state, shows that the plastic nature of the clay prevents gravitation, and the process of evaporation in a deep bank must be slow. More than once when the base of the slip was on the same level as, and extended to the bottom of, the ordinary open side ditch, a pipe-drain filled with rubble was substituted with advantage.

COURT DECISIONS ON DISPUTED BOUNDARIES.

In locating a patent of ancient date, evidence in respect to marked trees, though not called for on the grant, is admissible. Topping *v.* Sadler, 5 Jones' Law (N. C.), 357.

In ascertaining the lost corner or boundary of a section, which must be presumed, in the absence of evidence to the contrary, to have been established and marked in the original survey, recourse must be had to the unobliterated marks and corners of that survey; the field notes and plat, and subsequent surveys made under their guidance, although such subsequent surveys are not proved to correspond in every particular with the original survey. If only a portion of one of the boundary lines leading to the lost corner has been obliterated, the remaining portion, whether straight or not, as marked, must be considered as established; and the corner must be presumed, in the absence of evidence to the contrary, to be at the point where the marked line, if continued, would intersect the township line. But if the lost corner is proved to have been at another point, the lost portion of the boundary must be ascertained by running a straight line from the point at which the marks disappear to that corner. Billingsley *v.* Bates, 30 Ala., 378.

The corners and boundaries of sections, as marked and run by the United States surveyors in their original surveys, although not located with mathematical precision, are established by law as the proper corners and boundaries, and cannot be altered or controlled by other surveys. *Ibid.*

In an action of boundary, where the titles of both parties are derived from the same original vendor, the calls of the titles of the parties as understood at the time they were made, and according to the usage of the country at that time, cannot de disregarded on account of more recent surveys made by the government, which would change their boundaries. Lawrence *v.* Burris, 13 La. Ann., 611.

Where adjoining proprietors, being unable to ascertain the division line, agree verbally upon a certain line, the agreement is binding, and improvements by one up to the line is notice thereof to a purchaser from the other. Houston *v.* Sneed., 15 Texas, 307.

The acquiescence of the proprietors of the adjoining lands in a particular line is not unfrequently referred to and received as evidence to determine their boundaries. Prior possession is notice of the claim of the person in possession to the purchaser of adjoining lands. Bolton *v.* Lann, 16 Texas, 96.

A division line, mistakenly located and agreed on by adjoining proprietors will not be held binding and conclusive on them, if no injustice would be done by disregarding it. Menkens *v.* Blumenthal, 27 Miss., 198.

The corners established by the original surveyors of public lands under the authority of the United States, are conclusive as to the boundaries of sections and divisions thereof, and no error in placing them can be corrected by any survey made by individuals or by a State surveyor. Arnier *v.* Wallace, 28 Miss., 556.

A boundary may be rejected when it is clear that it was inadvertently inserted, and that a tract with different boundaries was intended to be conveyed. Gibson *v.* Bogy, 28 Miss., 478.

When a given quantity of land is to be laid off on a given base, it must be included within four lines, so that the lines proceeding from the base shall be at right angles with it, and the lines opposite the base shall be parallel to it, unless this form is repugnant to the entry. Massie *v.* Watts, 6 Cranch (U. S.), 148; Kerr *v.* Watts, 6 Wheat. (U. S.), 550.

A grant under a patent, of an island, by name, adding the courses and distances of the lines thereof, which, on resurvey, are found to exclude a part of the island, will nevertheless pass the whole island. Lodge *v.* Lee, 9 Cranch (U. S.), 237.

Where the Supreme Court of the United States has affirmed the title to lands, and referred in its decree to a particular survey, it is not proper for the court below to open the case for rehearing for the purpose of adopting another survey. Chaires *v.* U. S., 9 Howard (U. S.), 611.

The Surveyor General has no right to divide a fractional section by arbitrary lines, so as to prevent a regular quarter-section from being taken, if the fraction will admit of it. Brown *v.* Clements, 5 Howard (U. S.), 650.

The meander lines run in surveying fractional portions of the public lands bordering upon navigable rivers are run, not as boundaries of the tract, but for the purpose of defining the sinuosities of the banks of the stream, and as the means of ascertaining the quantity of land in the fraction, and which is to be paid for by the purchaser. Railroad Co. *v.* Schurmeir, 7 Wallace (U. S.), 272. —*Dunn's Land Laws.*

THE GREAT BALLOON FAILURE.

CHICAGO, Sept. 17.—A special to the *Times* from St. Paul says King's great balloon lies prone on the ground, and the vaunted expedition to the sea is at an end. The gale which began Wednesday lasted all through Thursday, and the balloon struggled like a thing of life to break the cords which bound it to earth in the woods near St. Paul. In the struggles the neck of the monster was loosened and the gas began to escape. Nothing could be done to stay the leak. One might as well try to stop a train of cars by clinging to the platform of the last coach as to restrain that frantic neck. It lashed the netting like a thing of life, with force enough to knock an elephant crazy. Several attempts were made to capture the infernal thing and hold it long enough to get a cord around it, but it could not be done, and the æronauts abandoned the job after getting thrashed unmercifully. The bottom and sides of the balloon presented an immense surface for the wind to play against; more, indeed, than the spread of canvass on the largest ship, and the strain was simply terrific. The stones and sand in the basket must have weighed six or seven thousand pounds, and added to this was the restraining influence exerted by three anchors held down by rocks that three men could not lift, and by four or five stout rope cables attached to trees. Yet every once in a while the balloon would raise the car clear off the ground, and tug at the ropes with the strength and determination of a locomotive that has been cut loose. At three o'clock in the afternoon of Thursday Prof. King saw that the case was hopeless. Two-thirds of the hydrogen was gone, and the wind was forming the envelope into a parachute, and blowing into it with an energy that threatened to tear the whole pasture up by the roots and fling it into the face of heaven. "I must do something or the balloon will be gone," said King, and he went for the valve rope. He discovered that it had became entangled in the rigging, and fully half an hour elapsed ere he could get it into working order. Then came a mighty struggle. The chained monster resisted the united strength of twenty men for an hour longer. They swarmed up the rigging every time the wind bore the balloon to the ground, and tried with all their power to hold it down, but in vain. It rose without an effort and threw the clinging atoms of humanity about like nine-pins. Those who hung on were carried high into the air, or switched over the ground and into the bushes like dish-rags. The air was full of flying legs, and the earth was mopped by the forms of reporters, Fort Snelling soldiers and others. The fight was intensely exciting, and for a long time the result was in doubt. The rip-cord at length tore a great gash in the side, and with every throb the enraged leviathan grew weaker, until at last it lay upon the ground a quivering mass. The air was oppressive with the smell of hydrogen, but the brave fellows who had assisted in reducing the inanimate thing to subjection did not let go till it was flat enough to sit on. By 6 o'clock all the party except King, Holden, and Upton were on their way to St. Paul, five miles distant, where they arrived an hour and a half later, cold, wet, exhausted and disgusted. They were mad at everything, but they could not find it in their hearts to blame Prof. King for the failure of the expedition. The elements had been against them from the start.

COST AND PROFITS OF TELEGRAPHY.

The figures from the official reports of the Western Union Telegraph Company may help us in our search for cheap telegraphy. The volume of business transacted by the company has increased from 1867 to 1880 from nearly six million messages to

twenty-nine million, or almost fivefold. If all these messages were sent by the single Morse system, the length of wire ought to have increased in something like the same proportion, for it cannot be imagined that the operators have gained very much in skill in that time. In 1867 there were 85,291 miles of wire. In 1880 there were 283,534 miles of wire. The messages increased nearly fivefold, the wires over which they were sent did not increase quite threefold. Clearly the Duplex and the Quadruplex have proved of benefit to some one. In thirteen years the capacity of all the wires of this company has doubled. What of the price of telegrams? In 1867 it is reported at an average toll of 104.7 cents per message. In 1868 it had fallen to 89.3 cents. In 1875 it had come down to 54 cents, or nearly one-half. Before the creation of the present Western Union, the average rate, it is said, was $1.20 per message. At the time of the two tariffs cited, in 1848 and 1852, there were a great number of competing companies, and to send a message any great distance required the payment of a number of different tolls. By the consolidation into one great company one toll was established, to the great gain of the company, and also to the public. In 1875 the average price is reported at 54 cents—a gain of nearly one-half since 1867. The Quadruplex was introduced the year before, and in 1878 was in general use on all the main lines, and the company's plant was doing nearly a fourfold duty. Did the price fall in like proportion? It does not so appear.

In 1867 the price of the raw material from which sulphuric acid was made was $61 a ton, and the selling price of the acid was 2¼ cents per pound. In 1879 the raw material was $23 a ton and the acid 1⅛ cents per pound. The difference in the price of acid and the cost of material, it must be remarked, was also affected by improvements in the process of manufacture, the gain being estimated at about fifteen per cent. Sulphuric acid and the metals zinc and copper are the chief costs of a battery, and yet the acid has fallen since 1867 from 2¾ to 1⅛ cents a pound. However, we need seek no further in this direction, for within two years a more wonderful step has been taken in this field of science. The dynamo-electric machine, driven by steam power, has replaced the battery, and, according to good authority, reduced the expense of obtaining the required current of electricity at least one-half. In addition to this, it is said that in other directions the cost of transmitting telegrams has been greatly reduced within a few years. For instance, more perfect insulation has been secured, and better methods of construction are employed. The Quadruplex system acts as a police by driving the operators up to their work. No man can loiter over his key while seven others are watching him. The price of wire has also fallen materially, and, with perhaps the exception of poles, everything used in telegraphy is much cheaper now than in 1867.

Between 1867 and 1875 the report shows a gain of nearly one-half. Between 1875 and 1880 the average toll is reported to have fallen from 54 cents to 43.6 cents, or only 10.4 cents. In this time the Quadruplex was generally introduced, the price of materials continually fell, and the battery was replaced by the dynamo-machine.

Suppose that by some mechanical marvel the capacity of the Croton aqueduct had been suddenly quadrupled, and without in any way increasing the size of the pipe. Clearly, if there were sufficient water in the Croton River, the people would get four times as much water, and the Water Commissioners would be fully justified in reducing the water rates to one-half. This is precisely what the Quadruplex has done for the telegraph.—*Charles Barnard, in Harper's Magazine for October.*

THE DEGENERATION OF STEEL.

What a superb career steel has renounced. It has shaped the world; it had carved out history; it had formed the nations; it had fixed the limits of languages and the geography of character and thought; it had vanquished the strong; it had rebuked the proud; it had succored the weak; it had been the arbiter of honor and the accomplisher of justice. The sword was, as the ancient chronicles said, the oldest, the most universal, the most varied of arms, the only one which has lived through time. All peoples knew it; it was everywhere regarded as the support of courage, as the enemy of perfidy, as the mark of commandment, as the companion of authority, as the emblem of sovreignty, of power, of force, of conquest, of fidelity and of punishment. And after all this has steel—to become rails. Look at what it was, and at what it is. Its aspect was brilliant, its habits were punctilious, its manners were courtly, its connections were patrician, its functions were solemn, its contact was ennobling; even its very vices were glittering, for most of them were simply the defects of its superb qualities. It is true that it was sometimes cruel, and that its processes of action were distinctly sanguinary, but those reproaches apply to all other weapons too. Throughout the ages it grandly held up its head and haughtily bore its name. It lost no caste when it allied itself with lance and dagger, with battle axe and helf, for they were of its natural kindred; and even when, in latter times, it stooped to generate such lowly offspring as razors, lancets, knives and needles, the world saw no real abasement in the act, for the chivalrous blade was still the image which represented steel to man. But now the whole character has changed; now it has thrown aside its gallantry, its grace, its glory; now it has foresworn its pride for profit, its pomp for popularity.

Steel is now bursting coarsely on the earth at the rate of thousands of tons a month. It is positively made into steam engines, and cannon, and ships, and all sorts of vulgar, heavy, uncomely, useful objects. Worse than all, it is becoming cheap. Steel cheap! The steel of old, the steel of legend and of story, the steel of the paladin and the chevalier, the steel of the noble and the brave, the steel of honor and of might, the steel that was above price, that knew not money and cared naught for profit—that steel is no more. It had been driven contemptuously out of sight by metallurgic persons called Bessemer, and Krupp, and Siemens, and these destructive creators have put into its place a nineteenth century substance exactly fitted to a mercantile period, but possessing no tie whatever with time or fame.

No more will steel append its personal signature, its glaring recognizable autograph to the great events of history. The dagger that slew Cæsar, the glaive that Brennus hurled into the scale to weigh against the liberty of Rome, the ax that gashed off Mary Stuart's head, the knife that armed the hand of Charlotte Corday—of course they were not all steel, but they admirably represent the notion of it—are mere faded antiquities. Steel has other functions to discharge now; it has given up marking dates in the world's life, and has gone in for trade: it has ceased to be history, and has become actuality; it is in a state of new departure: it no longer incarnates a sentiment; it is nothing but a fact. It has turned its back on the blades of Damascus, on the armor of Milan, on the shields of Augsburgh, on the rapiers of Ferrara, on the halberts of Flanders, on the poniards of Bilbao, and at this very moment is forsaking almost the last refuge which was left to it, and is deserting the marvelous sabres of Japan. In the place of its former glories, it has taken up all sorts of low associations; it is being manufactured in big furnaces; it is being "cast" as if it were mere clownish pig-iron; it is being rolled, as if it were uncouth "bar"; it is condescending to be boiler-plates, and axle-trees, and driving-shafts, and girders. To this is steel reduced.—*Blackwood's Magazine.*

THE LARGEST DREDGER IN THE WORLD.

The Glasgow *Daily Mail* of July 18th having published an account of a trial of a new dredger, built on the Clyde for Otago, New Zealand, which is described as having no equal either in Europe or America, and as being the largest dredger afloat, Mr. John Kennedy, Mem. Am. Soc. C. E., and Chief Engineer of Montreal Harbor and Ship Channel Improvements, writes to an English engineering journal that while the above statements may be true of the dredger in question, so far as regards size of hull and completeness of equipment and detail, yet as regards the size and working capacity of the dredging machinery proper, she is decidedly inferior to the best Canadian built dredgers, as, for instance, some of those belonging to the Harbor Commissioners of Montreal, and employed in the extensive work of the improvement of the ship-channel of the St. Lawrence. The Otago dredger, like those on the St. Lawrence, is of the kind having buckets connected together and forming an endless chain; but the St. Lawrence dredgers are attended by a tug and scows, while the Otago dredger has an internal mud-hopper, and is self-propelling, thus being, in fact, dredger, tug and scows combined, and requiring proportionately large hull. The Otago dredger cuts to 35 feet deep, as do those of the St. Lawrence, but the latter have buckets a third larger, and arranged so as to be very nearly twice as effective. The Otago dredger is reported to have raised at the rate of 400 tons per hour while filling her hopper, but the improved St. Lawrence dredgers easily fill their scows at the rate of 750 tons per hour, or nearly double the working rate of the "largest dredger in the world." For the hourly capacity for consecutive hours, something must be deducted for time lost in going to dump or to change scows, and in the case of the St. Lawrence dredgers this reduces the hourly rate to about 620 tons, still leaving them 60 per cent. better than the best rate of the Otago dredger. Average rates for a day or longer periods are further reduced for both kinds of dredgers by detentions for shifting anchors, moving out of the channel for passing vessels, and other contingencies not present in a mere trial of speed. The St. Lawrence dredgers, however, often raise 4,800 cubic yards in twelve hours, or an average of 500 tons per hour, while according to the published reports of July two of them raised an aggregate of 117,525 cubic yards of clay, giving an hourly average of 336 tons per dredge for the 69 hours on duty per week.

As a combined steamship and dredger, which can be turned out complete on the Clyde for export, the Otago dredger is the largest and the best thing yet, but as a machine to dig a channel, one of the compact, powerful Canadian dredgers will dig around her.

THE HISTORY OF THE SCREW PROPELLER.

The erection of a monument to Sauvage, who is believed to be the first to have practically applied the screw propeller to the driving of ships, has given rise in France to a discussion of the true history of the propeller, and the interesting fact has been elicited that it was actually applied on a small scale by Leonardo da Vinci about the end of the fifteenth century. That great artist and engineer endeavored all his life to find a means of flying; and though his admirable studies on the flight of birds are well known, few are aware that he invented several devices for elevating man above the ground and wafting him through the atmosphere. All these solutions of the aerial problem are independent of the principle of levitation, and aim at realizing flight by apparatus heavier than the air. Amongst these numerous plans, which can be seen in the *Codice Atlantico* deposited in the Ambrosian Library of Milan, and also in the volumes belonging to the library of the Institute at Paris, there is the design of a large screw destined to turn round a vertical axis, beside and below which are written some notes in Italian to the effect that the thread of the screw should be of iron wire stiffened with light supports, and covered with linen cloth having its pores stopped with gum. According to the author, when this screw is rapidly turned, it mounts into the air. The design is a very rough one, but it is perfectly clear, as may be seen at page 401 of the *Comptes Rendus* for Aug. 29. We see, therefore, that Leonardo da Vinci in all probability invented the screw propeller, and first applied it to aerial locomotion, thereby anticipating M. Tissandier in his recent application of the same device to a balloon by means of stored electricity. The latter employs bamboo for the framework of his screw, and curiously enough the Italian philosopher also suggests the us of long, stout reeds. Moreover, on consulting the *Saggio delle Opere di Leonardo da Vinci*, published at Milan in 1872, M. Govi finds that that universal genius had studied the effort exerted in striking the air with plates of a given size, and also invented the well-known parachute, of which a rough design is given, showing the figure of a man clinging to it.

TUNNELING MONT BLANC.

The French government has for some time past been contemplating the construction of a great railway tunnel in order to bring Paris and the northern parts of France into more direct communication with Italy than is afforded by the existing tunnel through Mont Cenis. The projects proposed include a tunnel through Mont Blanc, and another through the Simplon, or the Great St. Bernard. The last of the three has found very few friends, but it appears likely that both the former projects will be carried out. The projected Simplon tunnel is 60,719 ft. in length, while that through Mont Blanc is 44,292 ft. Comparing these with the other Alpine tunnels, we find that the Mont Cenis is 40,093 ft., and the St. Gothard 48,952 ft. long. The Simplon would, therefore, be the longest of all, but this is compensated for by the fact that it is at a much lower level than the rest,

the entrance at Brieg being only 2,333 ft., and that at Iselle 2,253 ft. above the sea level. The entrances to the Mont Blanc tunnel, on the other hand, would be 3,345 ft. at Montquart, and 4,215 ft. at Entrèves, above the level of the sea. The Bardimeèche entrance to the Mont Cenis tunnel is 3,970 ft., and that at Modane 3,799 feet above sea level, while in the case of the St. Gothard tunnel, the northern entrance at Goeschenen is 3,638 ft., and the southern at Airolo 3,756 ft. above the level of the sea. Thus the Mont Cenis tunnel is shorter, but 330 ft. higher than the Mont Blanc, while the Simplon would be almost half as long again, but would be about 10,000 ft. lower.

NOTES.

To harden steel take two teaspoonfuls of water, one-half teaspoonful of flour, and one of salt. Heat the steel enough to coat it with the paste by immersing it in the composition, after which heat it to a cherry red and plunge it into soft water. If properly done, the steel will come out with a beautiful white surface. Stubb's files are said to be hardened in this manner.—*Ex.*

THE EARLIEST CASTINGS IN IRON.

Cast iron is now in such general use that one might be apt to imagine that it had never been invented. But cast iron was not in commercial use before the year 1700, when Abraham Darby, an intelligent mechanic who had brought some Dutch workmen to establish a brass foundry at Bristol, conceived the idea that iron might be substituted for brass. This his workmen did not succeed in effecting, being probably too much prejudiced in favor of the metal with which they were best acquainted. A Welsh shepherd boy, named John Thomas, had some little time previous to this been received by Abraham Darby into his workshop on the recommendation of a distant relative. While looking on during the experiments of the Dutch workmen, he said to Abraham Darby that he thought he saw where they had missed it. He begged to be allowed to try, so he and Abraham Darby remained alone in the workshop all night struggling with the refractory metal and imperfect molds. The hours passed on and daylight appeared, but neither would leave his task, and just as the morning dawned they succeeded in casting an iron pot complete. The boy entered into an agreement with Abraham Darby to serve him and keep the secret. He was enticed by the offer of double wages to leave his master, but he continued faithful, and from 1709 to 1838 the family of Thomas were confidential and much valued agents to the descendants of Abraham Darby. For more than one hundred years after the night in which Thomas and his master succeeded in making an iron casting in a mold of fine sand contained in frames and with air holes, the same process was practiced and kept secret at Coalbrookdale with plugged keyholes and barred doors.

NEW SMELTING PROCESS.

The attention of capitalists and investors, and especially of iron manufacturers, is directed to the prospectus of the Dominion Duryee Furnace and Manufacturing Company, on another page, which presents a new process for smelting iron ores and converting them directly into malleable iron or steel. The Duryee Furnace promises such wonderful results that (if they be carried out) it must shortly supersede all other methods of conversion; it readily fuses the most obstinate and refractory ores, and all kinds at an expense of about seventy-five per cent. less than the most favored methods now in use. One of the most experienced and skillful metallurgists in the Dominion has thoroughly examined and practically tested the new process in the interests of certain Canadian capitalists and has pronounced it beyond doubt the most wonderful discovery ever made in connection with iron smelting. When we remember what a change was wrought by the invention of the Bessemer system and the immense advantages reaped by those directly interested therein it were not too much to claim for the Duryee process that it is destined to revolutionize the iron trade in this country, and confer upon the proprietors handsome profits upon their investments. One of the largest iron and steel manufacturers in the United States, who thoroughly tested its capacity for dephosphorizing ores, pronounced the operation perfect. The titanic ore, Baie St. Paul, Que., which has hitherto defied the utmost skill brought to bear upon it, was reduced by the Duryee process in between three and four hours to malleable iron blooms. The peculiarity of the furnace consists in the use of crude petroleum for fuel instead of coal and coke, the oil being fed in the form of a spray led into a strong blast from a rotary blower. Petroleum is very cheap and readily obtained, and the action of the blow-pipe in connection with the spray gives a most intense heat, easily regulated. We shall return to the subject in another issue.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Dalton, N. Y., is agitating a system of water works.

Work on the Arnold print-works water reservoir and pipe-laying at North Adams, Mass., have begun with a large force of men. The dam at the tunnel will be 250 feet long and 20 feet high, of solid masonry, and large enough to store 2,000, 00 gallons.

The people of the Eighteenth Ward, Cleveland, want water, and at a meeting held lately Mr. John Whitelaw, Chief Engineer of the Cleveland Water-works, proposed a plan of supply. It is proposed to build two reservoirs, which, with the necessary pipe-laying, would involve an expense of $1,250,000. An executive committee of fifteen was appointed.

The Brampton, Ont., Water-works are now being pushed vigorously ahead. The contract for the pipes has been let to Gartshore, of Hamilton, and the pipes are now being distributed along the trenches. Tenders for trenching and laying will be opened in a few days, and the works are expected to be in partial operation before winter sets in.

Mrs. Julia Ward Howe's suit against George H. Norman, of Boston, has begun at Newport. She asks the court to restrain the defendant from using a dam which he has built on the sources of a valuable stream flowing through Lawton's Valley, where she has real estate. She claims that the dam curtails the water-supply on her estate. The dam was built with a view of supplying Newport with water in case of accident to the reservoir in the adjoining town of Middletown. He bought a large tract of land in Portsmouth and built the dam complained of at great expense. Mrs. Howe a few months ago secured a temporary injunction, and she now hopes to make it permanent. The case attracts a good deal of attention.

Probably very few of the loungers about the Main street sewer stop to think what a world of unwritten early history is unearthed daily, in the digging. The long dark lines on either side of the trench, some three feet below the surface, indicate how much the street has been raised since the days when the heart of the city was a wild meadow, and reveal something of the quality of the soil. The old pump logs of aqueduct time, with their inch and a half bore, indicate a sparse population, and not a very large water supply. Occasionally stone drains lead from some building, like the old Hampden coffee-house, toward the town brook. Wherever the ground has been disturbed the abrasion in the earth can be easily seen, and usually the object of the diggers can be divined.—*Springfield Republican.*

ELECTRICITY.

The Edison Electric Light Company has received a contract for lighting the Paris Grand Opera-house.

BRIDGES.

A new bridge is being built at Louisville, Ky. The stonework has been let and the whole work is to be completed in 325 working days, and the structure opened for traffic Dec. 31, 1882.

The Connecticut River Railroad's wooden deck bridge, which crosses the Deerfield River at a mile south of Greenfield, 600 ft. long and 90 ft. above the river, was burned on the morning of the 21st. It will cost not less than $50,000 to build the new bridge, which will undoubtly be of iron.

MORRISBURG, Sept. 17.—The site for the International Bridge, in connection with the Morrisburg & Ottawa Railway, was located to-day. Mr. Keefer, of Ottawa, assisted by an engineering staff comprising Mr. Imlay, contractor; Mr. Searce, of Ottawa, and others, accompanied by Messrs. Farlinger, Munroe and Kennedy, of Morrisburg, examined the different locations along the river, and after a close inspection and taking several measurements of the river, it was found that the point at Mr. James Doran's, across to Ogden's Island, was the most desirable site. It is eminently satisfactory in every respect. The distance from the north shore across deep water at this point is only 400 ft., then a shoal, and not more than 7 ft. depth of water to Ogden's Island. The spot chosed will be particularly favorable to Morrisburg and Waddington, as offering great conveniences to these places. At Morrisburg the station can be brought south of the Grand Trunk line, in the center of the town, touching Waddington also at the heart of the village. The engineers conveyed their thanks to Mr. Munroe for his assistance. He is thoroughly conversant with all the peculiarities of the river in this section. While the engineers were engaged in this work two steamers passed up and one down, thus giving them a favorable view of the channel, and enabling them to select a spot that would not interfere with navigation.

RAILROADS.

The Burlington & Ohio River Railroad Company has been organized, and will at once, it is said, begin the construction of a railroad from Burlington, Iowa, to Golconda, Ill. The capital is $3,000,000.

Three thousand men are now at work on the completion of the link of the East Tennessee, Virginia & Georgia Railroad between Rome and Macon, Georgia. The steel for the eighty miles between Macon and Atlanta is now on the wharf at Brunswick. Tracklaying from Atlanta toward Rome will begin October 1.

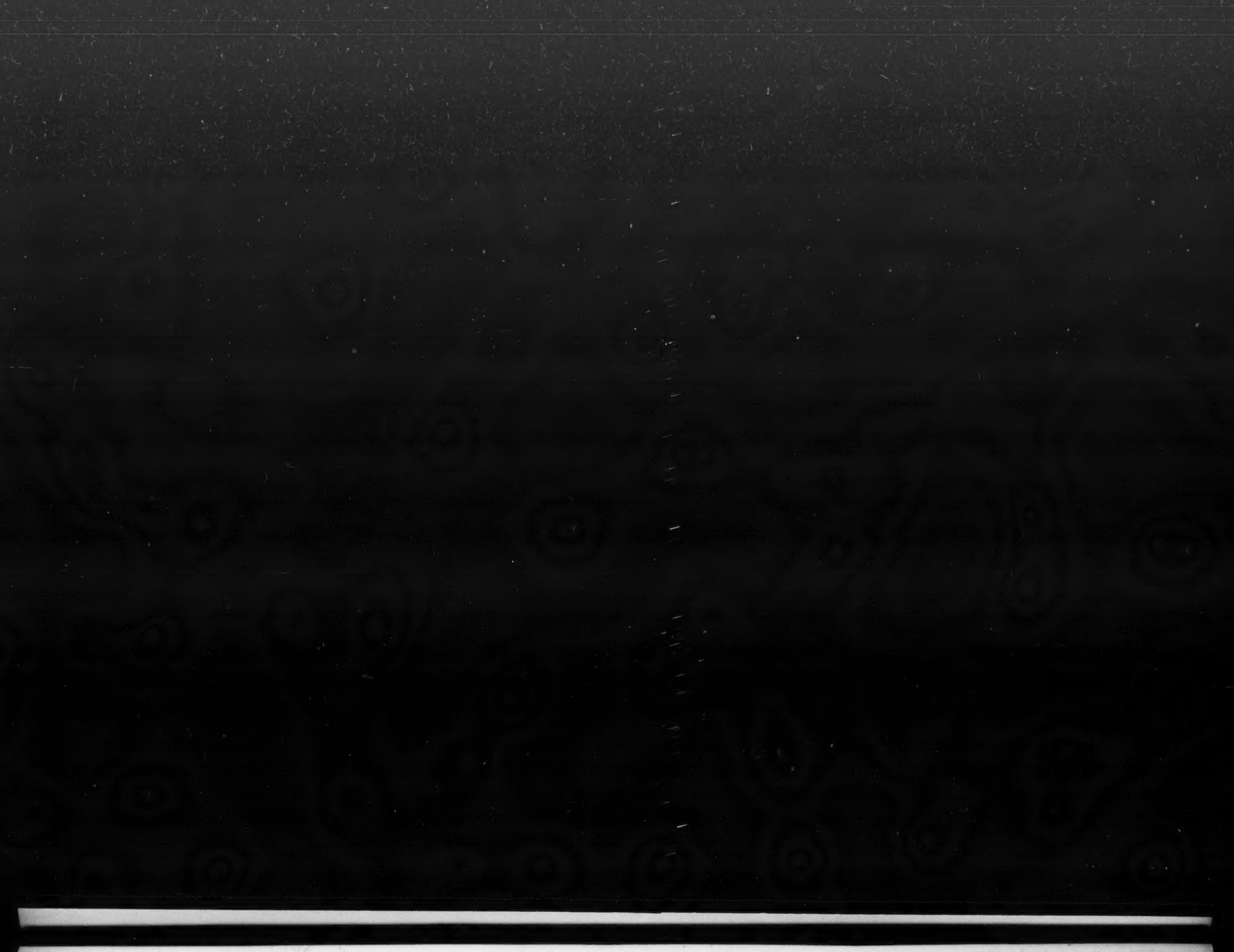
Mr. Henry Brachman, owner of the Cincinnati, Georgetown & Portsmouth road, has closed the contracts for sufficient iron to open the road from the present terminus to Georgetown, and the laying of the iron is expected to commence at once. During the past season the business of the road has materially increased, and the outlook for the future is very encouraging.

The New York, Pittsburgh & Chicago Railway Company have been securing right of way and stock subscription through Minerva, O., recently. They report better success than anticipated, and if the balance of the proposed route does as well as through this section, they will be ready to let the contract for grading about the first or middle of October.

A party of engineers under the direction of Mr. Thomas, of the Atlantic and Pacific road, have gone to Vinita, Indian Territory, where they will commence surveying a line for the extension of the St. Louis and San Francisco road across the Territory to Albuquerque, there to connect with the Atlantic & Pacific. The probabilities are that within two years the work will be completed.

CHATTANOOGA, Sept. 15.—Colonel Scott, General Manager of the Erlanger Syndicate, says that Chattanooga will be the headquarters for the shops of the entire system from Cincinnati to New Orleans, and spoke favorably of arrangements being perfected with the roads centering at Cincinnati for a combination whereby another through route from the south to the east will be opened. He says that he anticipates no injurious consequences to his system from the alleged alliance of the Cole and Huntington syndicate to build a road from Cincinnati to Knoxville.

THE SAFETY OF RAILWAY TRAVELING.—The annual report on railway accidents issued yesterday, if not in all respects an encouraging document, establishes the fact that an immense improvement in the working of our railways has taken place within a comparatively recent period. Little more than twenty years ago the chances of being killed while on a railway journey were nearly treble what they are now. Last year the number of passengers killed from causes beyond their own control was but one in twenty-one million journeys.—*London Standard.*

MORRISBURG, Ont., Sept. 16.—A full meeting of the M. & O. Railway Committee was held here to-day. There were from Ottawa Mayor Mackintosh, Mr. McTavish, Mr. Keefer, Murray Mitchell, C. E., and Mr. Soire, C. E. A letter was read from Hon. James Skead, regretting his not being able to attend owing to pressure of business. Mr. Morgan, of Metcalfe, arrived at the close of the meeting. John Rochester, M. P., and J. S. Ross, M. P., were both present, and offered any assistance in their power. The principal object of the meeting was to decide where the bridge was to cross the St. Lawrence. After an examination of the river by the committee it was decided to cross at Ogden Island. It was also decided to change the name of the road to the Ottawa, Waddington & New York Railway and Bridge Company. Immediate action is to be taken toward getting charters on both sides of the river. The meeting was of the most satisfactory nature. Mr. Soire, C. E., was set to work to take soundings of the river, and make a preliminary survey in order to get a charter. Hon. Mr. Pierce, of New York, was also present, and offered his aid to the scheme.

NEW YORK, Sept. 21.—A dispatch from San Francisco has been received in Wall street saying that Chief Engineer Montague, of the Central Pacific Railway, had received information from a surveying party under Engineer Warner, which started east from Ogden a few weeks ago to examine a new line for the extension of the Central Pacific road to the Missouri River. The engineer reported that he had found a favorable line through an open productive country, with grades not exceeding fifty-three feet to the mile, all the way from Salt Lake to Fort Fetterman, by the way of South Pass. Warner's party intended to continue its survey eastward until met by a party working west. The dispatch added that the officers of the road believe that a better road than the present one east of Ogden can be built for one-third of the cost. C. P. Huntington, of the Central Pacific, said that the assertions in the dispatch were all true. The officers of the road believed that the Union Pacific was encroaching on their rights west of Ogden, and therefore they intended to build an independent road from Ogden to the Missouri River. The surveying party had found a good road from the Pacific Springs all the way to the river, a distance of 740 miles. It was through an open, productive country about 100 miles north of the Union Pacific line. The road from Ogden to Pacific Springs, a distance of 100 miles, was not so good, but could be made available. About two months ago 60,000 tons of steel rails had been ordered from England, to be shipped by March 1, and they were expected in San Francisco by July 1. Mr. Huntington said that if the Union Pacific continued to build its connections with Ogden, the Central Pacific would certainly make an east connection with the Missouri River. The organization of a company to build the road could be effected in twenty-four hours, and the rails would be ready to begin the work at once.